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D21F 3/02

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(58) Documents cited

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US	4564059	US	4555305

(58) Field of search
D2A
Selected US specifications from IPC sub-class D21F

(54) Extended nip press

(57) An extended nip press comprising a fixed yoke 5, press shoe 7, flexible tubular casing 8, and non-rotating guide assembly 10 about which the casing is rotated in use is characterised in that the guide assembly is constructed such that it may be expanded or contracted to allow for changes in length of the circumference of the casing during use. The latter may be effected by means of an elastic tube 22 connected to a source of pressure, or by a spring. The guide assembly may be polygonal in cross-section or its outer surface may be provided with longitudinally-extending ribs and grooves, which may be straight or helical. The ribs may be radially elastic. Both casing and guide assembly may be moved towards and away from press roll 2 independantly of the press shoe e.g. by a hydraulic actuator. The sides of the guide assembly may be arranged to be slidable transverse to its axis.

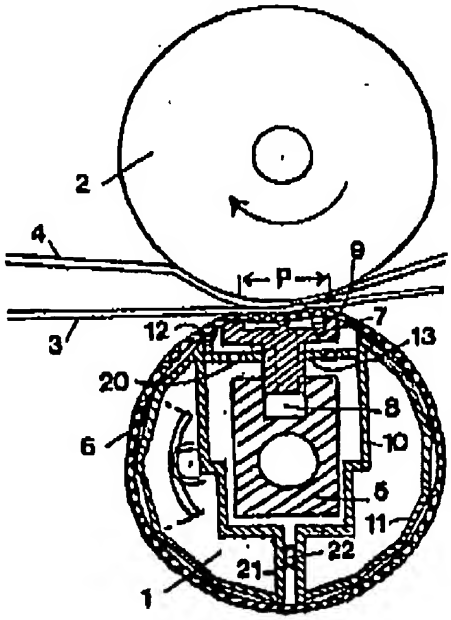

FIG.2

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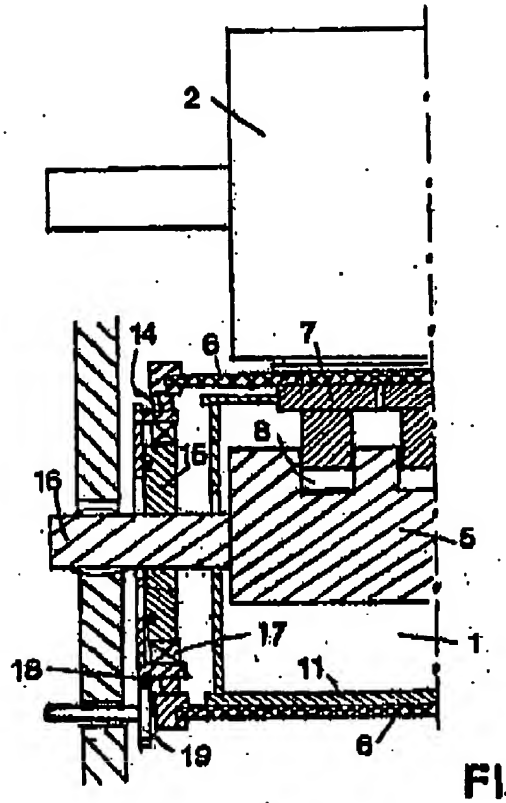

FIG.1

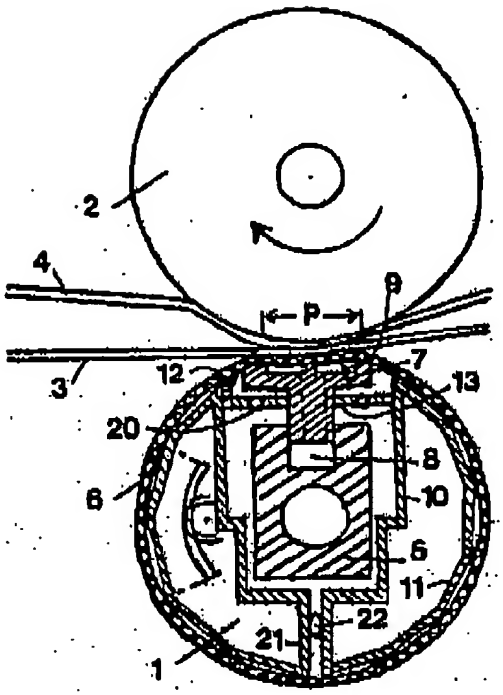

FIG.2

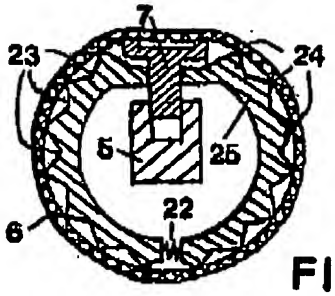

FIG.3

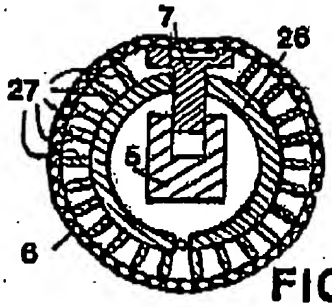

FIG.4

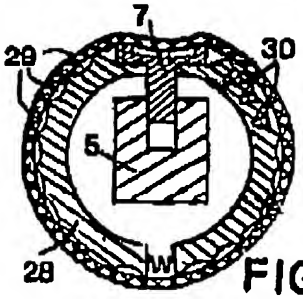

FIG.5

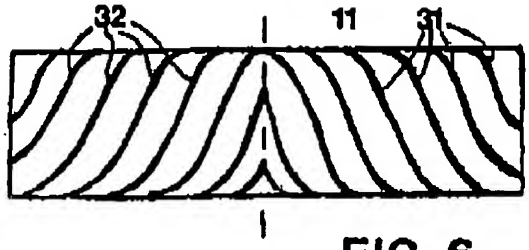

FIG.6

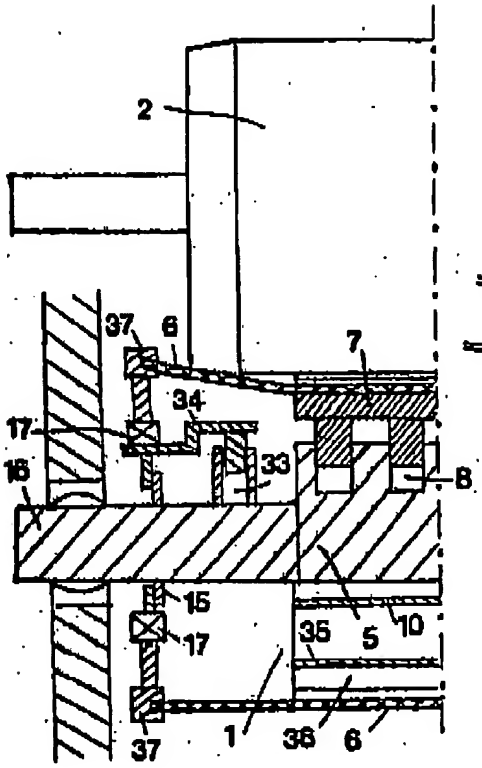

FIG. 7

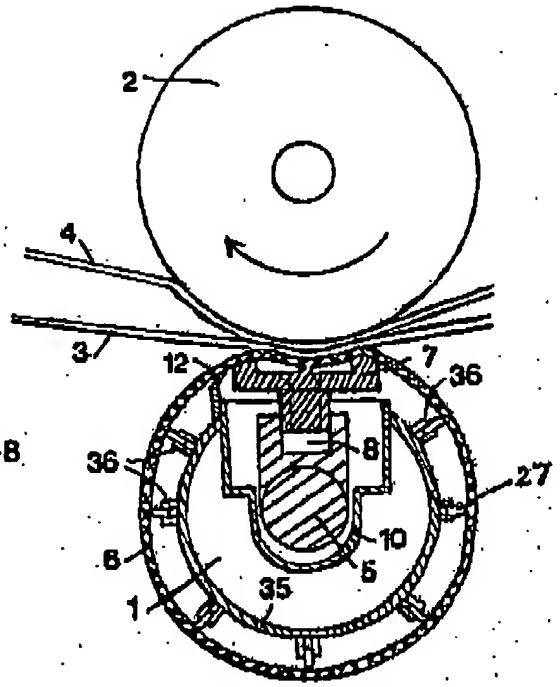

FIG. 8

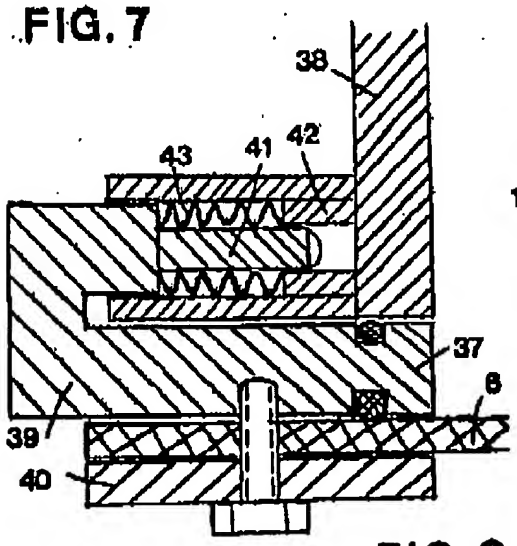

FIG. 9

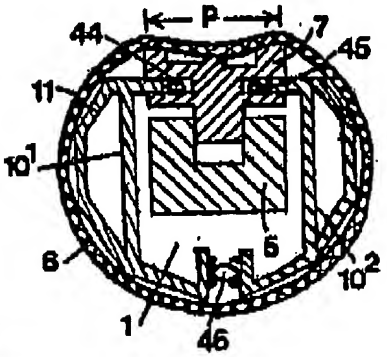

FIG. 10

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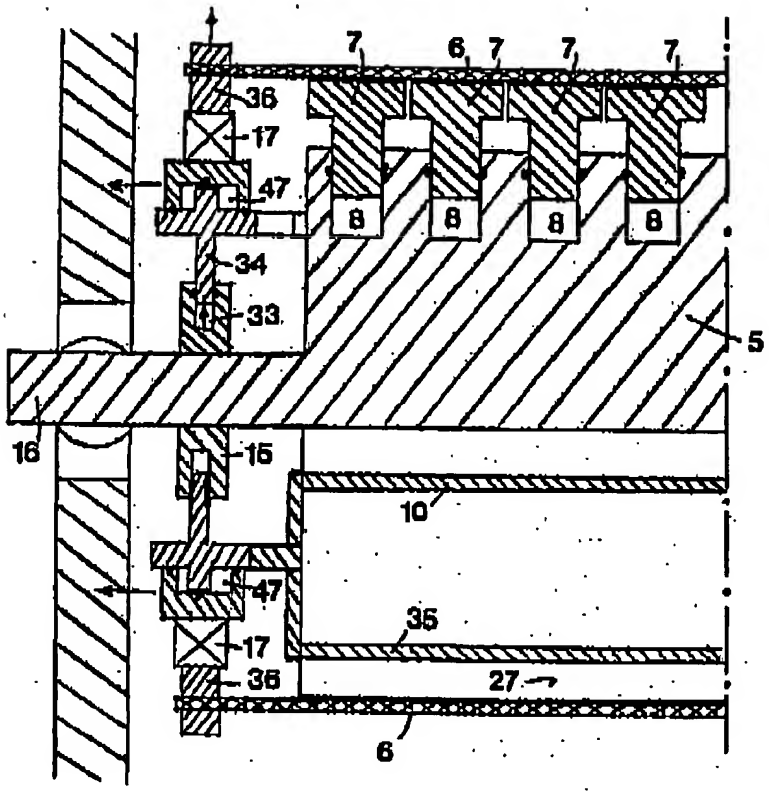

FIG.11

SPECIFICATION

Pressing device for dewatering a web of material

This invention relates to a pressing device for dewatering a web of material, for example a web of paper, of the kind comprising a flexible, tubular casing, which is rotatable about a non-rotatable guide member, a fixed yoke, and at least one pressing shoe which is supported by and movable in a pressing direction relative to said yoke, the pressing shoe(s) being located within said casing and being arranged to press the casing towards a counter roller in a pressing zone, in which zone the web of material and the casing are pressed between the pressing shoe(s) and the counter roller. Such a pressing device will hereinafter be referred to as "a pressing device of the kind set forth".

Such pressing devices of the kind set forth have been described, for example, in the following Patent Specifications, DE 33 17 455, DE 33 11 998, US 4 287 021 and GB 2 057 027 and are used, for example, in the pressing section of a paper machine or for dewatering a web of a different material. In using a pressing device of the kind set forth, a web of paper, usually together with at least one belt which absorbs water, e.g. a felt, is dewatered to a certain degree in a pressing zone extending over a part of the circumference of the counter roller and the pressing shoe, as a result of the applied pressure which is exerted by the pressing shoe. The tubular casing is provided between the pressing shoe and the web of paper, or respectively the felt and is rotated and guided over a guide member. It is intended that the casing should be guided over the guide member with a movement which is at least approximately free of tension and free of play. The pressing shoe is supported against the yoke, and between the pressing shoe and the yoke a pressure chamber is formed which is supplied with a suitable pressure medium, in order to bring about a desired amount of pressure applied by the pressing shoe onto the counter roller and onto the web of paper which is to be dewatered.

A requirement of such a pressing device is that on the one hand a good run-in and run-out of the casing over the edges of strips of the pressing shoe is ensured, and that on the other hand the friction between the guide member and the casing is not too great, so that the development of heat is minimal and that low drive power is required for the casing. The guide member should be able to balance out certain tolerances of the casing in the circumferential direction, which may lie in the order of up to 1% of the total length. However, good guidance is required and in order to prevent fluttering of the tubular casing, the latter must be axially taut and securely fastened to side plates.

In pressing devices with a pressing shoe which is supported against a yoke and with a guide member, a further problem is the opening of the pressing device, for example to change the felt or in an emergency, e.g. if the felt tears or if the paper web is unrolled, for which the pressing device has to be opened to such an extent that a play of from 40 to 60 mm results between the casing and the counter roller, and also the reinstalling of the pressing shoe or respectively the casing against the counter roller. The opening and closing of the pressing device should be able to be carried out quickly, safely in operation and with as little expenditure of force and energy as possible. Also, the pressing device should be able to be driven efficiently with the pressing gap opened.

Further problems are that the guide member must not deflect and that no straying of the casing must occur. If shoes with different nip lengths are used, the stroke of the guide member must also be adjustable, to ensure an efficient run-in and run-out.

With previously proposed pressing devices of the kind set forth, however, these problems have not been solved, or have only been solved incompletely.

In the pressing device which is described in US 4 287 021, the guide member has an unchangeable form, so that a balancing out of circumferential tolerances of the casing is not possible. The guide member is connected with the yoke, with respect to which the pressing shoe is movable in the pressing direction. An exact guidance of the casing over the guide member and at the same time over the edges of the pressing shoe can therefore scarcely be achieved. In order to open and close the pressing device, the entire unit consisting of the heavy yoke, the guide member and the pressing shoe must be moved simultaneously, for example, with adjusting devices on the bearing pins of the yoke or of the upper roller, which represents a considerable expenditure of force and energy.

A further pressing device is described in DE 31 02 626, in which a pressing shoe, against which pressure is applied hydraulically, is provided between the casing and the carrier or guide member. The carrier member is in turn supported hydraulically on the yoke. In order to open and close this pressing device, the pressure in two pressure chambers, between the pressing shoe and the guide member on the one hand and between the guide member and the yoke on the other hand, must be precisely co-ordinated one with the other, which requires a considerable effort in terms of regulation, or opening and closing takes place with the upper roller. Due to the considerable mass of the guide device or respectively the upper roller, here too the expenditure of time, force and energy to open and close the pressing device is in no way optimal and requires a regulating device, which can give rise to breakdowns. In addition, the pressing shoe is not sufficiently movable relative to the carrier member, so that a sufficiently exact run-in and run-out of the web paper can not be adjusted and no desired alteration is possible.

A pressing device is also described in DE 33 11 998, in which the carrier member has two radially movable strips close to the pressing shoe. A sufficiently exact run of the casing is not ensured through this, either. In addition, an axial prestressing of lateral gaskets of the casing is described therein, which does not, however, permit any mobility in the pressing direction.

It is an object of the invention to reduce or eliminate the disadvantages of the prior art

mentioned above, and in particular in a pressing device of the kind set forth, to improve the guidance of the casing over the guide member and over the pressing shoe, thereby to reduce the frictional resistance, to balance out circumferential tolerances of the casing, to avoid a fluttering of the casing, and to enable a quick opening and closing of the pressing device, which saves force and energy, to be achieved.

According to the invention there is provided a pressing device for dewatering a web of material, of the kind set forth, wherein at least one device is provided to alter the outer circumference of the guide member in order to balance out circumferential tolerances of the casing.

The device for altering the external circumference of the guide member may advantageously consist of several parts which are movable reciprocally and which are constructed so as to be able to be spread apart or slid apart, whereby the circumference of the guide member can be adapted to the circumference of the casing.

In the axial direction, an additional clamping device can be advantageously provided, in order to keep the casing always in the desired form, which at the same time permits an axial prestressing of the casing and also a displacement in the pressing direction.

The guide member may advantageously be movable and settable separately from the pressing shoe, so that the height of the guide member relative to the pressing shoe can be adjusted to an optimum run-in. In the setting procedure, firstly the guide member is positioned with side plates and only then is the pressing shoe brought up.

In order to enable the invention to be more readily understood, reference will now be made to the accompanying drawings, which illustrate diagrammatically and by way of example some embodiments thereof, and in which:—

Figure 1 is a longitudinal section through an end part of a pressing device,

Figure 2 is a cross-section of the pressing device shown in Figure 1,

Figures 3 to 5 are cross-sections of respective different embodiments of a pressing element,

Figure 6 is a plan view of a guide member,

Figure 7 is a longitudinal section through an end part of a further pressing device

Figure 8 is a cross-section of the pressing device shown in Figure 7,

Figure 9 is sectional detail of a casing attachment for a pressing element,

Figure 10 is a cross-section of a further pressing element, and

Figure 11 is a longitudinal section through a third end part of a pressing device.

Referring now to the drawings, the pressing device shown in Figures 1 and 2 comprises a pressing element 1 which co-operates with a counter roller 2 to press a web of paper 4 or other material which is to be dewatered, and which is passed together with a felt 3 through the pressing gap between the pressing element 1 and the counter roller 2. The counter roller 2 is constructed as a substantially rigid roller which is solid or hollow, or as a deflection equalizing roller.

The pressing element 1 has a fixed yoke 5, about which there runs a flexible, tubular casing 6. This casing may consist of rubber, which if required may be reinforced with a textile or steel fabric, or it may consist of a suitable elastomeric synthetic material. At least one pressing shoe 7 is provided inside the casing 6 and is supported by the yoke 5 by means of a pressure chamber 8 which is acted upon by a suitable pressure medium, such as oil, water or emulsion, so that as a result of the pressure of the pressure medium in the pressure chamber 8 the pressing shoe 7 is pressed against the counter roller 2 and thereby compresses and dewaters the web of paper 4.

The pressing shoe 7 may be a single, strip-shaped supporting shoe which is continuous in the axial direction, and which is supported by a single strip-shaped piston on a slit-shaped pressure chamber 8 in the yoke 5, or it may consist of individual, separate pressing shoes which are arranged closely adjacent to each other in the axial direction, and which are supported by separate pistons in separate pressure chambers 8. If required, one axially continuous pressure shoe may be supported on several pistons and several pressure chambers.

The surface of the pressing shoe 7 has a form which corresponds to the form of the counter roller 2. In this way, an extended pressing zone P results for the dewatering of the web of paper, whereby the dewatering effect can be distinctly improved compared with known pressing zones provided between two rigid rollers. In order to be able to achieve this advantageous effect, the casing 6 which revolves with the counter roller 2, the web of paper 4 and the felt 3, has to have a sufficient flexibility in order to be able to adapt to the form of the counter roller 2 in the pressing zone P.

The bearing surface of the pressing shoes 7 may be provided with pressure pockets 9, which are connected by bores with the pressure chamber 8, in a similar manner to hydrostatic support elements, as are known in deflection equalizing rollers, for example from US 3 802 044. However, the pressing shoes 7 may also be constructed in a different manner, for example as hydrodynamic bearing shoes in accordance with US 4 287 021. In order to ensure a good run-in of the casing 6 into the pressing zone P and also a good run-out from this zone, it is expedient to shape the edges of the pressing shoe 7 accordingly, for example to round them off.

In order to achieve a trouble-free passage of the casing 6 through the pressing zone P, there is provided inside the casing 6 a non-rotating guide member 10 over the outer side 11 of which the casing 6 is able to slide at least approximately free of tension and free of play. As low a tension as possible is desirable in the casing in order to avoid frictional losses and to keep the drive power low. On the other hand, the casing must not be too slack, either, i.e. have too much play, so that flutter phenomena and the risk of damage are avoided at the very fast rotational speeds in modern paper

machines.

In order to reduce the frictional forces, the outer side 11 of the guide member is constructed in the form of a hollow body of polygonal cross-section, so the at the casing 6 only runs over its edges. In order to achieve an efficient guidance of the casing 6 over the outer side 11 of the guide member, it is advantageous if the number of polygonal edges is of the order of from 10 to 20. A small quantity of pressure medium can enter through the cavities formed between the outer side 11 of the guide member and the tubular casing 6, so that a good lubrication and hence a low friction can be achieved. In order to remove excess pressure medium, a skimmer 12 is provided on the guide member, close to the run-out of the pressing shoe.

The inner part of the guide member 10 is formed such that it can slide in the pressing direction along the yoke 5, but such that a transverse movement is avoided. In one embodiment, a part 13 of the guide member on the pressing shoe side may be attached to the pressing shoe 7 so that the entire guide member is only able to be moved together with the pressing shoe in the pressing direction. On lowering of the pressure in the pressure chamber 8, consequently the pressing shoe 7 together with all the parts 10 to 13 of the pressing shoe and the casing 6 is moved back simultaneously contrary to the pressing direction, whilst the yoke 5 remains stationary. If a value of 40 to 60 mm is provided as the maximum stroke of the pressing shoe, the pressing device can consequently be opened without the heavy yoke 5 having to be moved, and the pressing device can thereupon be closed again with a low expenditure of energy. As the relative position of the pressing shoe 7, casing 6 and guide member 11 remain unchanged on opening and closing the pressing device, in this procedure the casing tension remains approximately at the same low level, so that an efficient run of the casing is also retained when the pressing device is in the opened state.

Advantageously, however, the pressing shoe 7 may also be movable independently and relative to the guide member 11, if required. On closing the pressing device, firstly the guide member 11 can be raised to an adjustable position and the pressing shoe can then be operated, whereby an efficient and optimum run-in is achieved.

In normal operation, the casing 6 is taken up and driven by the counter roller 7, the web of paper 4 and the felt 3. In order to avoid slippage of the casing and tensions occurring thereby, and in order to be able to also drive the casing 6 when the pressing device is opened, which facilitates the closing of the pressing device, optionally in auxiliary drive may be provided for the casing as shown in Figure 1. At the end of the casing 6 a gasket ring 14 is provided, which co-operates with a gasket 15 on a bearing pin 16 of the yoke 5 and outwardly seals the interior of the casing 6, but permits movement of the casing 6 in the pressing direction. Between the gasket ring 14 of the casing 6 and the gasket 15 of the yoke 5 a ball race 17 is provided, which permits the rotation of the casing 6 about the yoke 5. The gasket ring 14 carries a toothed rim 18, with which a pinion 19, which can be driven from the outside, engages on both sides of the casing 6, by which the casing 6 can be set in rotation with a lower expenditure of energy.

In order to be able to absorb circumferential tolerances of the casing, which may be up to 1%, and also circumferential changes of the casing during operation, the guide member is constructed such that its outer circumference can adapt to the casing circumference, so that a play-free run is always ensured and maintained, with as low a tension as possible.

For this purpose, the guide member, as shown in Figure 2, is divided into several parts, which are connected to each other by joints 20, so that a spreading apart of the guide member and hence an adaptation of the outer circumference of the guide member to the inner circumference of the casing is possible. This may occur for example in that between outer arms 21 of the guide member a variable spacer 22 is provided, for example a spring or a pressure tube. Thereby, a small amount of force is sufficient to prevent a play and a fluttering of the casing, without the casing being stressed in a disturbing manner and the friction thereby being increased.

Whereas in the embodiment shown in Figure 2 the outer surface 1 has the form of a polygon with a plurality of edges running in the axial direction, other forms may also be advantageous.

Figure 3 shows a guide member 25, the outer surface of which has wedge-shaped notches 23 running in its longitudinal direction. Here, too, the casing 6 runs over a sufficient number of contact points 24, so that an efficient guidance is also ensured here. The guide member 25 is movable with the pressing shoe 7 and its two parts can be moved apart by a spacer 22.

In the embodiment shown in Figure 4, a plurality of cross-pieces 27 are arranged on the outer side of the guide member 26 and run in the axial direction, the casing 6 being arranged to slide over the cross-pieces.

In the example illustrated in Figure 5, the grooves 29 are formed, on the outer side of the guide member 28, whereby the effect is analogous to that in the embodiments previously described. In order to improve the lubricating effect, these grooves 29 may be connected to lubricant supplies 30. This is expedient, if not necessary, in particular in the case where the grooves are shallow or where the outer surface of the guide member is almost smooth. With a sufficient groove depth, however, as a rule the pressure medium collecting in the interior of the pressing element is sufficient as a lubricant, in order to ensure efficient movement of the casing 6.

Instead of running in the axial direction of the guide member, the grooves or cross-pieces on the outer side of the guide member may also be run inclined thereto, as shown in Figure 6. Here, the outer side of the guide member 11 is formed with grooves 31 and 32 which run helically. In order to prevent an uneven loading of the casing, it is expedient to provide spiral lines which run

differently on the two sides of the guide member. For example, in the guide member shown in Figure 6, the grooves 31 on the right hand side have the form of a right hand screw, whilst the grooves 32 on the left-hand side have the form of a left-hand screw. At the same time, it can be achieved hereby that collecting lubricant is automatically transported to the two ends of the casing, where it can be removed.

In the pressing device shown in Figures 7 and 8, the guide member 10 is not securely connected with the pressing shoe 7. Instead, a hydraulic adjusting cylinder 33 is provided against the bearing pin 16 of the yoke, which cylinder is supplied with pressure medium independently of the pressure chambers 8, with which the pressing shoes 7 are supported on the yoke 5. Via a linkage 34, this adjusting cylinder 33 moves a ball race 17 of the casing 6 with its lateral gaskets 36 in the pressing direction, and consequently also the guide member 10 which is mounted in the interior of the casing 6, and also an inner gasket ring 38 which co-operates with the fixed gaskets 15.

The pressure in the pressure chambers 8 and the adjusting cylinder 33 is regulated by a suitable device such that the movement of the casing 6 and of the guide member 10 takes place as desired with respect to the movement of the pressing shoes 7. The movement of the pressing shoes thereby is analogous to the examples previously described, i.e. either in synchronism with the guide member or, however, the possibility may also be provided to raise the guide member or respectively the roller, without the pressing shoe abutting.

According to Figure 8, in a similar manner to that shown in Figure 4, a plurality of cross-pieces 27 are provided, running in axial direction, on the outer part 35, over the outer edges of which the casing 6 is guided. The number of cross-pieces here must be selected to be sufficiently great and the width of the intermediate spaces sufficiently small, in order to ensure an exact run of the casing. The cross-pieces 27 may additionally be constructed so as to be slightly elastic in radial direction, so that they are able to balance out circumferential tolerances and changes. In addition, a sub-division of the guide member and a spreading apart can be provided for tolerance equalization.

In the further development of the invention which is shown in Figure 9, the clamping of the casing 6 with respect to the gasket 36 may also be constructed so as to be elastic in the axial direction at at least one end of the casing 6. In the example shown, the casing 6 is screwed onto a base member 39 with a clamping ring 40. The base member 39 carries a pin or cross-piece 41, which is able to slide in the axial direction in a cylinder or slit 42 which is formed by an extension of the gasket ring 36. A set of plate springs 43 which is provided between the two parts presses the two parts apart and thereby causes a tightening of the casing 6 in the axial direction. By this step, the run of the casing over the guide member is further improved.

In the pressing element 1 shown in Figure 10, the guide member is not, as in Figure 1, composed in two parts connected articulatedly with each other, but rather of two parts 10^1 and 10^2 which can be slid in a direction transverse to the axis and which are pressed apart from each other by elastic elements 45, 46 and 47, so that here, also, a balancing out of casing circumferential tolerances and a smooth, friction-free and flutter-free run of the casing is achieved.

Figure 11 shows a particularly advantageous further development of the embodiment according to Figure 7, in which the lateral gasket 36 and the radial adjustment devices 33, provided for example with an adjustable extension, lie in one plane. At the same time, the end part of the roller which is constructed in such a way contains a hydraulic clamping device 47, which presses the bearings 17 and the gaskets 36 outwards, and axially tightens the casing 6 which is attached to the gaskets 36. As all the elements of lateral limitation therefore lie in the same plane, a particularly favourable and compact construction of the roller is produced.

Modifications and further developments of the present pressing device are possible. Although it is advantageous, as in the described embodiments, to press the pressing shoes against the counter roller hydraulically by means of a pressure chamber which is provided between the yoke and the pressing shoe and which is supplied with pressure medium, other methods of pressure application may also be used. For example, the pressing force may also be carried out mechanically, e.g. by suitable springs, electromagnetically or pneumatically. Also, use is not restricted to the dewatering of webs of paper, but rather use can be made in principle with all webs of material which can be dewatered under applied pressure in a pressing zone, e.g. textile webs. Corresponding adaptations, such as dimensioning or omission or use of other accompanying belts or screens in place of the conventional felt in paper manufacture lie within the scope of ability of those skilled in the art.

CLAIMS

1. A pressing device for dewatering a web of material, of the kind set forth, wherein at least one device is provided to alter the outer circumference of the guide member in order to balance out circumferential tolerances of the casing.

2. A pressing device as claimed in Claim 1, wherein the guide member consists of at least two parts, which can be moved relative to one another by means of a spreading device.

3. A pressing device as claimed in Claim 2, wherein the spreading device has elastic elements or elements which are hydraulically, pneumatically or magnetically operated.

4. A pressing device as claimed in any one of Claims 1 to 3, wherein the ends of the casing are connected with gaskets, and wherein an adjusting device is provided for moving the casing, the gaskets and the guide members in the pressing direction.

6. A pressing device as claimed in any one of Claims 1 to 4, wherein the ends of the casing are connected with gaskets, and wherein a clamping

device is provided for pressing the ends of the casing outwards in the axial direction.

6. A pressing device as claimed in Claims 4 and 5, wherein the adjusting device and the clamping device are arranged at least approximately in the same plane vertically to the yoke.

7. A pressing device as claimed in any one of Claims 4 to 6, wherein the adjusting device includes a pressure chamber and at least one pressure chamber is provided between the pressing shoes and the yoke, there being means for supplying the pressure chambers with pressure medium, so that the movement of the casing end of the pressing shoes relative to each other can take place independently.

8. A pressing device as claimed in any one of Claims 1 to 7, wherein the pressing shoes are constructed as hydrostatic support elements, which on their support surface have at least one bearing pocket connected by a bore with the pressure chamber provided between the yoke and the pressing shoe.

9. A pressing device as claimed in any one of Claims 1 to 8, wherein the outer side of the guide member is polygonal in section thereby having a plurality of edges, or is formed with a plurality of grooves with edges between them, the said edges having an axial component of direction, the arrangement being such that the casing is guided over said edges.

10. A pressing device as claimed in Claim 9, wherein the grooves have the form of a spiral on the outer side of the guide member.

11. A pressing device as claimed in Claim 10, wherein the direction of rotation of the spirals on one end of the guide member is opposite to the direction of rotation on the other end of the guide member.

12. A pressing device as claimed in any one of Claims 1 to 8, wherein cross-pieces over which the casing is directed are provided, on the outer side of the guide member and are movable in the radial direction.

13. A pressing device as claimed in Claim 12, wherein the cross-pieces are constructed so as to be elastic in the radial direction.

14. A pressing device of the kind set forth substantially as hereinbefore described with reference to Figures 1 and 2, or Figures 1 and 2 as modified by any one of Figures 3 to 6, or Figures 7 and 8 or any one of Figures 9 to 11 of the accompanying drawings.

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